Information Sheet on
FACTORS THAT AFFECT QUALITY IN THE FREEZING PRESERVATION OF PEAS

Western Regional Research Laboratory, Albany, California
Bureau of Agricultural and Industrial Chemistry
Agricultural Research Administration
U. S. Department of Agriculture

This information sheet has been prepared in response to frequent requests for information that can be used by packers of frozen peas in improving the quality of their output. Only those phases of processing that are most critical in their relation to quality are discussed. A number of these are being studied in this Laboratory. Some of the results of investigations have been published (see list on page 6). Further results will be reported later. Because of the desirability of holding bacterial numbers to a minimum, special consideration has been given to sanitation.

Varieties

The basis for selection of varieties of peas to be frozen consists chiefly of such factors as disease-resistance, yield, and date of maturity. The quality of a variety when frozen is an important matter but requires less consideration because, among the varieties available, all or nearly all yield an excellent quality of frozen product.

Usually the packer stresses greenness of seed coat, large size, and high sugar content. These qualities are found in garden varieties such as Thomas Laxton, Glacier, Laxton's Progress, Stratagem, Tall Alderman, Teton, and Hundredfold. Some of the canning varieties such as Perfection and Wisconsin Sweet meet the sugar requirements but are smaller in size and lighter in color. In spite of this, some people prefer these canning varieties to the accepted freezing varieties because of difference in flavor. However, most of the peas frozen commercially are of the market-garden type.

Information on disease-resistance, yield, and maturing date can best be obtained from seed companies and State experiment stations in the localities being considered.

Effect of Harvest Maturity on Quality

The maturity at which peas are harvested has an important effect on the quality of the frozen product, and is also of considerable importance from the standpoint of yield. Peas harvested too soon are small and watery. As maturity progresses the starch content increases and size and yield become greater. These changes are desirable up to a certain point, which might be called prime maturity; beyond this point the peas become hard and starchy, and skin texture and color are undesirable. Prime maturity might be defined as that at which the pea is sweet and has a characteristic flavor, a uniform green color, and similar texture in skin and cotyledon. (A simple test for texture is the chewing test; skin and cotyledon should break down at the same rate.)

Contrary to common belief, peas do not decrease materially in sugar as they mature. The apparent decrease is due to an increase in starch, which seems to make the peas taste less sweet. The sugar content is a characteristic of the variety; varieties and types differ widely in these respects. Variations within a variety may be due to soil and climatic factors.

Increases in yield as the peas go beyond prime maturity are also a varietal characteristic, which depends on the relationship of the rate of increase in size to the rate of accumulation of starch. In other words, some varieties reach maximum size before their starch content is very high, whereas others have a comparatively high content of starch when maximum size is reached. Sufficient data have not been accumulated to make possible a recommendation of varieties on the basis of these observations, but a study is being pursued and will be reported later.

The following methods are used for the measurement of maturity:

Tenderometer: This instrument, developed by Martin and coworkers (1)*, is used extensively by both canning and freezing plants in judging the harvest maturity of peas. The readings obtained on peas are often used as a basis for payment to the grower. The measurement simply involves bringing the peas to a certain temperature in water and then placing them in the instrument, which measures the amount of force necessary to shear them. This shearing force is closely related to the maturity or starch content of the peas.

The principal criticism of the instrument is the lack of a standard for its adjustment, in order to assure the packer that his readings are comparable to those given by the instruments used by his competitors. Friction between growers and packers has occurred because of this difficulty. Comparison of the instrument with another method of grading which has a fundamental basis such as starch content may prove to be the answer to this problem.

Percentage of Sinkers in Brine: This method of grading measures the density of peas and is used extensively to determine the grade, both before and after freezing. Present Government grade standards for frozen peas are based on the percentage of thawed, skinned peas that sink in certain concentrations of salt brine. The method is simple, requires a small amount of equipment, and can be carried out at any time. Results by this method appear, however, to be only fair approximations. Correlations with tenderometer readings, starch contents, and results of taste tests show large deviations which are due to inadequacy in the brine test.

Starch Content: A method of evaluating maturity by the starch content of peas has been proposed recently (2). It is less rapid than the tenderometer and probably more rapid than the brine method. As it measures starch, which gradually increases in peas as they mature, the method rests on a fundamental basis which is less subject to question than any other procedure that has been

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*References are listed on page 6.

proposed. The principal drawback at present is lack of sufficient data on allowable limits of starch content for a given grade of peas. Studies on the subject are under way.

Sieve Size: A few packers depend almost entirely on size grading to segregate peas into different grades of maturity. Investigation has shown that this method has a definite weakness. If one plot of peas is harvested on a given date and a similar plot a few days later, peas of a given size from the one plot frequently differ in tenderometer reading, starch content, and density from peas of the same size harvested from the other plot.

Effect of Delays on Quality

In the handling of peas, delays frequently occur. If equipment is inadequate during the peak of the season there may be a long wait between mowing and vining. There is evidence that this delay may cause considerable increase in the tenderometer readings.

The viners are often located a considerable distance from the processing plants, and if plant facilities are not sufficient to handle the peak load of the season, long delay may again occur before the peas can be processed. Studies on the effect of this delay period (4) indicate that losses in nutritional and organoleptic quality begin to occur as soon as the peas are vined. If, however, temperatures are moderate these losses as judged by flavor and skin texture may be relatively small in the first 5 to 6 hours. As peas are removed from the pods they become contaminated with bacteria. The increase in bacterial count is small for the first 4 or 5 hours; from then on the rate of increase becomes greater. Evidence indicates that most of the loss in quality after the first few hours of delay is caused by bacteria growing on the peas rather than by respiration and other internal changes. Deterioration in quality becomes very marked when the bacteria begin to multiply rapidly.

The present practice is to ice the peas, if delay periods are anticipated. The most satisfactory method is to precool them in ice water, drain, and mix them with cracked or powdered ice. If this is done the peas can be held for much longer periods without great loss in quality. Perhaps other methods, such as washing with various detergents and bacterial-growth inhibitors, may prove to be successful in minimizing the deteriorative effects of delay.

Some operators have considered the possibility of blanching the peas before they are hauled to the processing plant. This would prevent enzymic breakdown of the product if delay should occur before processing could be continued. As has been shown above, however, losses in quality due to internal change are relatively small in ordinary delay periods but bacterial effects may be very severe. Blanched material is a more favorable medium for bacterial growth than is unblanched, and therefore blanching to prevent spoilage due to delay is not recommended.

Blanching

Peas can be blanched in either steam or water. The difference in amount of leaching by the two methods is too small to be considered a factor in the choice of a method. The most common blancher in use at present is a cylindrical

screw-type water blancher. The temperature is held around 200° F. and the peas pass through it in about 90 seconds. If steam blanching is used, the ordinary continuous-belt type is suitable. The blanching time will depend on rate of loading on the belt and the temperature. The time necessary for the inactivation of the enzymes can be determined by the peroxidase test (6).

If the water used for blanching is hard, it may be advisable to add a polyphosphate such as sodium hexametaphosphate to prevent the toughening of the pea skins (3). This procedure is relatively simple and the costs are small compared to the gain in quality of the peas. After they have been blanched, the peas should be immediately cooled with water sprays or by fluming in cold water to a temperature of 70° F. or less.

Sanitation

Cleanliness, speed, and low temperature (cooling) are the three factors that make for sound sanitary practice. Poor sanitation must be regarded as an important source of difficulty in pea-freezing plants, giving rise to sourness, off flavors, and other factors detrimental to quality.

Within the plant, effective sanitation is imperative, but fortunately need not be expensive. The chief requisites are: (a) a well trained and always available cleaning crew, (b) plenty of potably clean cold and hot water, (c) soap or other cleaning agents, (d) stiff-bristled brushes, (e) easily cleaned equipment and floors, and (f) sanitary and well appointed toilet and wash rooms.

Because it provides information on bacterial numbers at various key points, the following tabulation is worthy of study. It was obtained from 46 bacterial-count studies in 13 pea-freezing plants.

Point of sampling	Thousands of bacteria per gram of peas
Platform	11,346
After washing	1,090
After blanching	10
End of flume	239
End of inspection belt	410
Entrance to freezer	736
After freezing	560

These data represent averages. Findings from one plant where extremely heavy contamination was found are omitted. In this plant the contamination was 30 million bacteria per gram at the end of the inspection belt. The quality of the frozen peas was in keeping with the bacterial content.

The following cleaning recommendations are offered:

1. Clean the line thoroughly after each run. Cleaning should include flushing of the entire line, first with cold water and then with boiling hot water or steam. Frequent use of hypochlorite or other effective cleaning solution is advisable.

2. Apparatus in which peas can become lodged should be given special attention at frequent intervals. Use of a clean, stiff-bristled brush may be necessary.

3. The brine in the quality grader should be changed frequently and the grader should be cleaned thoroughly at the end of each run.

4. The inspection belt is a prolific source of contamination. Daily use of a cleaning solution is necessary. Cleaning should include all parts of the frame with which the belt comes in contact.

5. Be sure that gray slime does not collect on any of the equipment. Appearance of slime on gooseneck elevators, sides of flumes, and elsewhere is evidence of gross negligence in cleaning.

6. Elevator boots and other less conspicuous places are likely to escape close inspection. One dirty elevator boot was found to increase the bacterial count of peas from 30 thousand to over 1 million per gram.

7. During continuous running in the peak season, when it is impossible to clean the line thoroughly at any one shut-down, it is good practice to flush the entire line and thoroughly clean a portion at each shut-down. This practice should insure at least one thorough cleaning of the line each day.

8. See that workers are personally clean. Good health, clean clothing, and clean personal habits must be insisted on.

9. Whenever possible, advantage should be taken of the services of a competent bacteriologist. Preferably, bacteriological tests should be run at various points on the line; at least the bacterial content of the newly-frozen peas should be determined. Tests on peas that have been in storage for some time are likely to be misleading, because many of the bacteria are then dead and cannot be counted. The technique of bacteriological tests is not presented in detail here; it may be mentioned, however, that collection of 50- or 100-gram samples, crushing of the samples, plating in suitable dilution in glucose agar at pH 7.0, and incubation for 4 days at 70° F. constitute a reliable method. Counts on peas from a well-run plant should not exceed 400,000 per gram. The direct microscopic test (5) on frozen peas can be recommended. It offers several advantages, including rapidity. Details of this test will be supplied on application to the Western Regional Research Laboratory.

Literature Cited

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